

# 5XIC0 – Electronic Systems Engineering Study Guide 2024/2025

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September 12, 2024

## Revision history

- September 12, 2024: Initial version

## Contents

<b>1</b>	<b>Introduction</b>	<b>1</b>
<b>2</b>	<b>General information</b>	<b>1</b>
<b>3</b>	<b>Lecturers and contact information</b>	<b>2</b>
<b>4</b>	<b>Course material</b>	<b>2</b>
<b>5</b>	<b>Learning objectives</b>	<b>2</b>
<b>6</b>	<b>Pre-requisites</b>	<b>3</b>
<b>7</b>	<b>MS Teams</b>	<b>3</b>
<b>8</b>	<b>The systems-engineering project</b>	<b>3</b>
<b>9</b>	<b>A note on collaboration and reporting</b>	<b>3</b>
<b>10</b>	<b>A note on the use of AI (such as Co-Pilot and ChatGPT)</b>	<b>4</b>
<b>11</b>	<b>Examinations</b>	<b>4</b>
<b>12</b>	<b>Schedule</b>	<b>5</b>

## 1 Introduction

This study guide provides information for 5XIC0 - Electronic Systems Engineering. The course is organized through Canvas (<https://canvas.tue.nl>). Check Canvas for all the latest information.

## 2 General information

**Planning:** Semester A, Quartile 2, Time slot A - Mo 1-4, Th 5-8

**Format:**

- DBL
- Written midterm exam (individual)
- Systems-engineering project (in groups of three or four students)

- Final exam based on project deliverables

**Level:** Bachelor College, advanced

**Target audience:** Electrical Engineering, Automotive Technology, Computer Science and Engineering, Mechanical Engineering

**Elective package:** System Design & Analysis

**Credits:** 5 EC

### 3 Lecturers and contact information

- Prof.dr.ir. A.A. (Twan) Basten (responsible lecturer) [a.a.basten@tue.nl](mailto:a.a.basten@tue.nl)
- Dr. M. (Martijn) Hendriks (co-lecturer) [m.hendriks@tue.nl](mailto:m.hendriks@tue.nl)
- M. (Mahtab) Modaber (TA, primary contact for project support) [m.modaber@tue.nl](mailto:m.modaber@tue.nl)
- R.W.M. (Roel) van Os (TA) [r.w.m.v.os@tue.nl](mailto:r.w.m.v.os@tue.nl)

### 4 Course material

- Slides, project assignment, all available through Canvas
- SysML reference, one of the following two books:
  - A Practical Guide to SysML: The Systems Modeling Language, Sanford Friedenthal, Alan Moore, Rick Steiner, The MK/OMG Press, 3rd edition, freely available in pdf format via the TU/e at <https://www.sciencedirect.com/book/9780128002025/a-practical-guide-to-sysml>
  - SysML Distilled - A brief Guide to the Systems Modelling Language, Lenny Delligatti, Addison-Wesley, available as e-book via the TU/e library.

Hardcopies/print outs can be used as reference during the midterm exam.

- SysML 1.6 specification, in particular Annex D which gives many examples (recommended) <https://www.omg.org/spec/SysML/1.6/PDF>
- NASA Systems Engineering handbook, Rev 2. (optional - background reading) <https://www.nasa.gov/connect/ebooks/nasa-systems-engineering-handbook>
- Software (the project description on Canvas contains installation instructions)
  - Papyrus (SysML tooling)
  - POOSL (discrete-event simulator for performance analysis)
  - TRACE4CPS (an add-on to POOSL for visualization of simulation runs)

### 5 Learning objectives

After attending this design-based learning (DBL) course, students should:

1. Be able to successfully apply an electronic-systems design process, as practiced in industry.
2. Know and be able to use a standard systems-design notation (SysML) in the (requirements) analysis, design, and documentation phases of a systems design process.

3. Be able to make motivated design decisions taking into account relevant system-level performance indicators and requirements.
4. Be able to select and successfully apply relevant modeling and analysis techniques in support of design decisions.

## 6 Pre-requisites

No specific prior knowledge is needed.

## 7 MS Teams

To facilitate communication, we have set up a team in MS Teams. Questions regarding the course content, the project, and the course organization can be asked through MS Teams, so that all information is available to all course participants.

## 8 The systems-engineering project

The project is to design and optimize a manufacturing system. See Canvas for a detailed project description. You will work in groups of three on this project. If the number of participating students is not a multiple of three, (at most two) groups of four may be formed. Note that groups of four students need to deliver more to compensate for the additional person compared to groups of three students (details are in the project description on Canvas). **Please register yourself for a group in Canvas, but only if you are fairly sure that you can finish the course, since dropping out after the project has started is very inconvenient for your team and for the course in general.**

To have transparency about the contribution of each team member, everyone is **required to keep an individual weekly logbook**. This is implemented as eight separate **group** assignments in Canvas (with their deadlines on Friday 23:59). Your group delivers one file with the individual logs of each team member, in which you report on your activities of the last week. Failing to deliver logs in time will have a negative impact on the individual project grade, as decided by the lecturers.

**Support for the project is provided during regular class hours and via a dedicated channel in the Teams team.** Please ask your questions as much as possible during class and/or in the Teams channel. Two further **opportunities for obtaining systematic feedback** on the project progress are given. SysML and POOSL models may be submitted for review according to the schedule outlined below.

## 9 A note on collaboration and reporting

The project is a group assignment. When working on assignments, discussions with your fellow students of other groups, are allowed, and even stimulated if they contribute to a better understanding. The use of external sources (like research papers or software tools) is allowed and can positively contribute to the evaluation of your project result. The following guidelines need to be taken into account though:

- **All submitted work**, being reports, models, scripts, or anything else, **has to be the work of the group members**.
- **External sources need to be referenced adequately.**

- If you divided the work among group members, where each of the group members have different roles, then please include a short reflection on the division of work in your report.
- If you collaborated with other students, then please report also on such collaborations.

Violating any of these requirements may lead to failing the course. Depending on the severity of the violation, the examination committee may take additional measures. **All work will be checked for plagiarism/copying upon submission in Canvas.**

## 10 A note on the use of AI (such as Co-Pilot and ChatGPT)

The use of AI tools for the assignment is **permitted**. If you use any such tools (even if only for polishing text), you **need to report on the use** in your final report. Explain what tool(s) you used, for what purpose(s), and what was the impact on your work. Failing to report on the use of AI tools is, in line with the TU/e regulations, considered fraud and will be sanctioned by the examination committee.

## 11 Examinations

The examination has two components:

- An **individual**, written midterm exam on SysML modeling (30% of the final course grade) Covered material: the SysML lectures, and the book parts referred to in the SysML slides. The exam is open book, meaning that you may use books, lecture notes and any other printed materials as you see fit. You cannot use any electronic devices (laptops, tablets, phones) because these enable communication with others, which is not allowed during the midterm.
- A final exam consisting of the project deliverables (handed in per group) as defined in the project description on Canvas (70% of the grade with a required minimum grade of 5 for this part). The deadline for the project deliverables is **Friday January 17 2025**, and is enforced by Canvas. Missing the deadline means that you fail the Q2 examination, but can still participate in the Q3 resit.

**Grading of the project work** is done as follows. Each group gets a number of points that are to be distributed over the members. This distribution leads to individual grades per group member and is decided by the group. Only grades of halves on a scale of 0 to 10 are allowed, with a difference between the grades of group members of at most 1.0 point. The examiners need to approve the proposed grades and may deviate from the proposal with a proper motivation (e.g., based on the (absence of) the individual progress logs).

A **final presentation session** is organized on Monday January 13 2025, in which you present your solution to the lecturers and your peers. Make sure to also have your SysML and POOSL models available for demonstration. You will get feedback that you can use to improve your solution and final report before submitting it.

A **re-examination** can be done any time during Q3. But only the **final exam (project deliverables) can be re-done**. The **midterm cannot be redone**. The Q2 midterm grade will be taken into account for the final-grade computation of a re-exam. All the project material developed in Q2 may be re-used. It should then of course be improved to improve your grade. If you revise work that was already submitted and assessed in Q2, then please include a clear **change log** in your Q3 report. If you fail the course after the re-exam, and still want to pass the course, then you will have to participate again next year.

**You must have your student ID card** for the midterm exam and for the final presentation session.

## 12 Schedule

Please always check Canvas and MS Teams for possible updates and changes. The course is built from the following modules:

- M0: Organization
- M1: Introduction to systems engineering
- M2: Systems-engineering project introduction
- M3: Systems-engineering process
- M4: Performance engineering
- M5: Cost & market analysis
- M6: SysML language (divided in sub modules a – e)
  - a Use cases
  - b Requirements
  - c Blocks
  - d Activities
  - e Allocations
- M7: POOSL toolset

The planning is as follows (here the numbering is according to the week numbering of Q2 in the calendar of the academic year) :

### 1. Intro week

- Monday Nov 11
  - 08:45 – 09:30 : M1
  - 09:45 – 10:30 : M0
  - 10:45 – 11:30 : M2 – **Introduction of systems-engineering project**
  - 11:45 – 12:30 : M6a
- Thursday Nov 14
  - 13:30 – 14:15 : M3
  - 14:30 – 15:15 : M6b
  - 15:30 – 17:15 : Project work

### 2. SysML week

- Monday Nov 18
  - 08:45 – 09:30 : M4
  - 09:45 – 10:30 : M6c general blocks
  - 10:45 – 11:30 : Project work
  - 11:45 – 12:30 : M5
- Thursday Nov 21
  - 13:30 – 14:15 : M6c block internals, interfaces, flows
  - 14:30 – 15:15 : M6c design alternatives, parametrics
  - 15:30 – 17:15 : Project work

### 3. SysML week

- Monday Nov 25
  - 08:45 – 09:30 : Project work
  - 09:45 – 10:30 : M6d
  - 10:45 – 11:30 : M6e
  - 11:45 – 12:30 : Project work
  - **CANVAS DEADLINE 23:59 – Papyrus model for feedback**
- Thursday Nov 28
  - 13:30 – 14:15 : Project work
  - 14:30 – 16:15 : Q&A on SysML (input from handed-in models)
  - 16:30 – 17:15 : Project work

### 4. Midterm week

- Monday Dec 2
  - 08:45 – 12:30 : Project work, midterm preparation
- Thursday Dec 5
  - 13:30 – 15:15 / 15:30 : **Midterm exam** (till 15:30 for students with extension)

### 5. POOSL week

- Monday Dec 9
  - 08:45 – 12:30 : M7
- Thursday Dec 12
  - 13:30 – 17:15 : Project work

### 6. Project week

- Monday Dec 16
  - 08:45 – 12:30 : Project work
- Thursday Dec 19
  - 13:30 – 17:15 : Project work

### 7. Project week

- Monday Jan 6
  - 08:45 – 12:30 : Project work
  - **CANVAS DEADLINE 23:59 – POOSL model for feedback**
- Thursday Jan 9
  - 13:30 – 15:15 : Q&A on POOSL (input from handed-in models)
  - 15:30 – 17:15 : Project work

## 8. Finalization week

- Monday Jan 13
  - **CANVAS DEADLINE 8:45 – presentation**
  - 08:45 – 12:30 : Group presentations
- Thursday Jan 16
  - 13:30 – 17:15 : Group presentations (if needed), project work
- Friday Jan 17: **CANVAS DEADLINE 23:59 – project deliverables**

**Enjoy the course!**

Martijn, Twan, Mahtab, Roel